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PAPER ON THE GULF STREAM AND CURRENTS OF THE SEA.

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I am invited, in the name of the National Institute, to address this meeting on the Gulf Stream and other currents of the sea. This is an important subject—important to civilized man in the every-day business of life, and vitally important to all who use the sea: whatever relates to it, therefore, can not fail to be highly interesting and important to a nation so renowned as this is for its maritime pursuits.

Upon a correct knowledge of the force and set of currents on the Ocean, often depends not only the safety of vessel and cargo, but the lives of all on board; and, owing to the want of this knowledge, hundreds of vessels, thousands of persons, and millions of property are annually cast away or lost at sea.

I do not intend to occupy the time of members with a recapitulation here of what we do know with regard to Ocean currents; that indeed might soon be told; for we know little or nothing of them, except that they are to be met with here and there at sea, many of them sometimes going one way and sometimes another; and that the waters of some of them are colder and of others warmer than the seas in which they are found. That we should have a better knowledge of them, and of the laws which govern them is not only an important matter to those who follow the sea, or make ventures abroad, but it is also a matter of exceeding interest to all those whose enlarged philanthropy, or ennobling sentiments prompt in them a desire to diffuse knowledge among their fellows, or in any manner to benefit the human race. The mere fact that this meeting is held at all, is evidence ample and complete, that it is composed altogether of such. I therefore submit it is a question for the consideration of this meeting, whether it be not competent for the National Institute to devise and set on foot a plan for multiplying observations and extending our information upon these interesting phenomena. A subject of vast importance in the business of commerce and navigation, the currents of the ocean seem to me to be altogether worthy the attention of this society—a series of well conducted observations upon them would be in perfect unison with the great objects of usefulness for which it was created and now exists, and for which its distinguished members and guests have been invited, and are here assembled from all parts of the country.

Before such an assemblage of mind and intelligence, it is necessary only to mention the meagre state of our information even with regard to that great anomaly of the Ocean, the Gulf Stream, and there will be—there can be but one mind as to the importance of making further observations, and of multiplying facts with regard to it. In simply reminding the society, that all we know of this wonderful phenomenon is contained chiefly in what Doctor Franklin said of it more than 50 years ago, that his facts were collected by chance as it were, and his observations made with but few of the facilities which navigators now have, I feel that enough and all has been done that is necessary to be done, in order to impress the Institute with the importance of further observations upon it.

Were it the Institute only that is concerned in the matter, I would not say a word more on the subject, believing that all that I can say will add nothing of force to the appeal contained in the mere announcement of the fact just stated. But we live in a utilitarian age; we belong to a community of people eminently utilitarian in their habits of thought and motives of action; and, when they are called upon to coöperate, as they must be in all great measures of usefulness undertaken by

an Institution so eminently national in its associations and its character as this is, the question "cui bono," on their part, must first be met, at least to some extent, before the requisite degree of coöperation can be obtained.

Distrustful of my ability to meet on the present occasion, this question as it can be met, and ought here to be met, I would cease from the attempt in hopeless despair, were it not for the respect which I entertain for the discernment of the distinguished members of the Committee who have selected me for the task.

As a people, we are disposed to do but little for science out of mere zeal for the cause. We are not apt to be prominent in any of its walks, unless we can perceive to our oft repeated "cui bono," frequent answers, like finger boards by the way side, to guide and to cheer us on. But when our way is thus made clear, it redounds not a little to the credit of the American people that they are foremost in pursuit.

Of this, the science of Geology affords a striking example. Chemistry and Astronomy in the Old World struggled for centuries in sickly infancy; but, on this side of the water, modern Geology, like the Goddess of old, leaped at a bound, fullgrown and panoplied into being. Immediately practical in its character and useful in its results, the people were eager in the pursuit of its principles. And for the honor of popular Institutions be it said, the States of Republican America have done more for the science of Geology than all the governments of all the world besides. They fostered it with a care and pursued it with an energy that no other department of science ever before received at the hands of a nation. But 'twas not for the mere love of science that geological investigations were thus encouraged among us. It was because its ends were adapted to our utilitarian ideas, and in themselves promptly answered the great question of utility now to be met.

Our researches in this field have revealed to us the fact, that the Ocean and its currents have been and no doubt still are important and active Geological agents. Of this truth, all the tide water country to the South and much of that to the North of us, is a present witness.

To say what agency the Gulf Stream and other currents now known to us, had in this formation, would carry us too far into the regions of speculation for our present purpose. But thus much we may venture: that between us and the Gulf Stream there is a current of cold water running towards the South with sufficient strength to produce important changes along the coast. Two hundred and fifty years ago, Sir Francis Drake with his fleet entered Albemarle Sound through Roanoke Inlet, which is now a sand bank above the reach of the highest tides. Only seventy years ago, it was navigable by vessels drawing 12 feet of water. An examination by skilful engineers is now being made as to the practicability of re-opening this inlet. In their eyes at least a correct knowledge of the effects and tendency of this current would be of great value.

This circumstance explains better than volumes of disquisition could do, the "cui bono" of collecting and recording every fact whatever that observation may give us with regard to the currents on our coast. That they are effecting important changes along the sea board, the singular chain of long and narrow islands that curtain the coast from Albemarle Sound to the reefs of Florida, gives ample evidence. These and the shoals which endanger navigation off the Capes of Carolina, owe their existence entirely to currents, or uplift. The soundings and form of the Hatteras and other shoals clearly indicate that they are caused by a current from the North. A comparison of present charts with Jeffry's atlas published in 1775, shows not only that these shoals are increasing, but that the chain of islands alluded to is in process of gradual formation. Currituck and Roanoke inlets which are now sand bars, once were navigable. Occracoke inlet had then 17 feet of water, it now has 8. Besides these there were between Beaufort, North Carolina and Charleston in South Carolina, 25 or 30 others, many of them then navigable, and most of them now closed and appearing only as dry land.

Whence comes the sand that forms these islands? Separated from the main land by standing pools of water moved only by the tides from the Ocean, it can not be brought from the shore. It can only be upheaved with the general elevation of the coast by geological agencies, or it is cast up from the bottom of the Ocean by the Gulf Stream and the waves, or brought down from the North by the current on the coast. Investigation might settle the question.

Linked thus with other geological agents, the currents of the sea can not fail to present themselves to the mind of the Geologist, as important and interesting subjects for investigation. How much more so are they in the eyes of the Navigator; with him, the source of this coast current is a matter of conjecture, and its cause a mystery. And as to its strength, its fluctuations and the laws which govern them, his nautical books are all but silent. Nor has the history of navigation recorded the first series of systematic observations upon it.

Proceeding furthur into the Atlantic, we find a vast stream of warm water running counter to this. It is the Gulf Stream bound from the Straits of Florida to the Banks of Newfoundland, and thence to the shores of Europe. What its breadth or its depth may be, we know not. We are told indeed that even at the same place it runs sometimes at the rate of two knots the hour, sometimes at five, and we know that it may always be found within

certain broad limits, varying in this too at the same place, from 140 to 340 miles. With this our knowledge of it ends; though more accurate information as to it and its offsets would many a time have saved the mariner from disaster, and his vessel from shipwreck, and even now, would add not a little to the speedy and safe navigation of the Atlantic.

Though Navigators had been in the habit of crossing and recrossing the stream, almost daily, for the space of near 300 years, its existence even was not generally known among them, until after Dr. Franklin discovered the warmth of its waters, about 70 years ago. And to this day, the information which he gave us, constitutes the basis, I had almost said the sum and substance of all we know about it.

When he was in London, in 1770, he happened to be consulted as to a memorial which the Board of Customs at Boston sent to the Lords of the Treasury, stating that the Falmouth packets were generally a fortnight longer to New York than common traders were from London to Providence, R. I. They therefore asked that the Falmouth packets might be sent to Providence instead of to New York. This appeared strange to the doctor, for London was much farther than Falmouth, and from Falmouth the routes were the same, and the difference should have been the other way. He however consulted a Nantucket whaler who chanced to be in London also; the fisherman explained to him that the difference arose from the circumstance that the Rhode Island Captains were acquainted with the Gulf Stream, while those of the English packets were not. The latter kept in it and were set back 60 or 70 miles a day while the former avoided it altogether. He had been made acquainted with it by the whales which were found on either side of it, but never in it. At the request of the doctor he then traced on a chart, the course of this stream from the Straits of Florida. The doctor had it engraved at Tower Hill and sent copies of it to the Falmouth Captains, who paid no attention to it. The course of the Gulf Stream, as laid down by that fisherman from his general recollection of it, is retained on our charts at the present day, almost without an alteration.*

If within the domains of Philosophy, there can be such a thing as a proprietary field of investigation, this phenomenon of a river in the Ocean is one—American in its source and origin, it is found in the waters of America, and closely concerns its navigating interests; first traced out by the fishermen of New England, it attracted the attention of the great American philosopher: he determined its most remarkable characteristic, and left it to his countrymen as a field to be re-occupied by them at some future day, and with a like spirit of philosophical research.

* Page 485 and plate XII., Vol. 6th Spark's Franklin.

Therefore the Gulf Stream offers a field of investigation peculiarly American, and we, the Americans, are in duty, as we are in honor, bound to show ourselves curious and diligent in whatever there may be about it, of undiscovered mystery, or of philosophic interest to navigation, or other branches of science.

In Dr. Franklin's time, the navigator *guessed* as much as he *calculated* the place of his ship—vessels from Europe to Boston frequently made New York, and thought the land-fall by no means bad. Chronometers, now so accurate, were then an experiment. The Nautical Ephemeris itself was faulty, and gave errors of thirty miles in the longitude. The instruments of navigation erred by *degrees* quite as much as they now do by *minutes*; for the rude "cross staff" and "back staff," the "sea ring" and "mariner's bow," had not yet given place to the nicer sextant and circle of reflection of the present day. Instances are numerous of vessels navigating the Atlantic in those times being 6°, 8° and even 10° of longitude out of their reckoning in as many days from port. Our means therefore of properly conducting a system of observations upon the currents of the sea, and for following up the investigations of Franklin, are much more ample and complete than they have ever been with navigators before. Therefore what society so appropriate as this, the National Institute of his country—what time more fit,—what occasion more suitable than the present for maturing a plan of operations, and for setting on foot a system of observations upon the Gulf Stream and its kindred phenomena of the sea?

As commendable in some respects as is that utilitarian spirit among us which is so apt to try our undertakings with "cui bono?" it is not wise always to start this question; for, the apparently trifling facts by which the laws of nature are often revealed to the philosopher and are made subservient to our purpose, will not, at all times, brook the inquiry.

When the Italian Philosopher commenced his experiments, what utilitarian saw in the fact elicited from the legs of a dead frog, the important consequences to which it has led us, and to this day continues to lead us! The principles deduced from his simple discovery, after having led to many important and valuable results, are now, at the end of half a century, being applied for our purposes in such a manner, that words spoken in yonder capitol, may be conveyed to other cities with the speed of lightning, and caught up there as they fall here from the lips of the speaker.

When our own Franklin flew his kite in the storm, who would have thought that the inkling which he then caught as to a law of nature would enable us to turn aside the artillery of heaven?

Or when, at another time, he dipped his thermometer into the sea, how could the most keen-sighted utilitarian have perceived that the fact thus

discovered would shorten the average passage across the Atlantic, at least one third; would bring the old world and the new nearer together by many days, and would wonderfully improve and benefit Navigation?

To the philosopher, every newly discovered fact, in physics, however trifling to others it may seem, is a gem. Our knowledge of nature and her laws is but a number of such facts, brought nigh and placed side by side. As they accumulate, they reflect light upon each other, and each generation becomes wiser and wiser, for every such fact thus gathered is but another clue placed in our hands, which, if carefully followed up, will lead us further and further out of the labyrinths of ignorance, and bring us nearer and nearer to the doors of everlasting knowledge. Therefore, in the proposed undertaking, let not the utilitarian's question be sprung too soon, or too loudly upon us.

No part of the world affords a more difficult or dangerous navigation than the approach of our Northern coast in winter. Before the warmth of the Gulf Stream was known, a voyage at this season from Europe to New England, New York, and even to the Capes of the Delaware or Chesapeake, was many times more trying, difficult and dangerous, than it now is. In making this part of the coast, vessels are frequently met by snow storms and gales which mock the seaman's strength and set at naught his skill. In a little while, his bark becomes a mass of ice; with her crew frosted and helpless, she remains obedient only to her helm, and is kept away for the Gulf Stream. After a few hours' run, she reaches its edge, and almost at the next bound, passes from the midst of winter into a sea at summer heat. The ice disappears—the sailor bathes his stiffened limbs in tepid waters; feeling himself invigorated and refreshed with the genial warmth about him, he realizes out there at sea, the fable of Antæus and his mother Earth. He attempts to make his port again, and is again as rudely met from the North West; but, each time he is driven off from the contest—he comes forth from this stream like the ancient son of Neptune, stronger and stronger, until, after many days, his freshened strength prevails, and he at last enters his haven in safety. I might name instances, for they are not uncommon, in which vessels bound to Norfolk or Baltimore with their crews enervated in tropical climates, have encountered, as far down as the Capes of Virginia, snow storms, that have driven them back into the Gulf Stream time and again, and have kept them out for 40, 50, and even for 60 days, trying to make an anchorage.

The number of shipwrecks that occurred on our coast during one month in the winter of '41, amounted to not less than three a day. How many were saved by seeking refuge with their frosted and disabled crews in the warm waters of the Gulf Stream, is matter of conjecture. Before their temperature was known, vessels thus distressed, knew of no place of refuge short of the West Indies; and the newspapers of that day,—Franklin's Pennsylvania Gazette among them,—inform us that it was no uncommon occurrence for vessels, bound for the Capes of the Delaware in winter, to be blown off and to go to the West Indies, and there wait for the return of spring before they would attempt another approach to this part of the coast.

Accordingly, Dr. Franklin's discovery of the Gulf Stream temperature was looked upon as one of great importance, not only on account of its affording to the frosted mariner in winter a convenient refuge from the snow storm, but because of its serving the Navigator with an excellent land mark or beacon for our coast in all weathers. And so viewing it, the Doctor concealed the discovery, for we were then at war with England. It was then not uncommon for vessels to be as much as 10° out in their reckoning. He himself was 5°. Therefore, in approaching the coast, the current of warm water in the Gulf Stream, and of cold water on this side of it, if tried with the thermometer, would enable the mariner to judge, with great certainty and in the worst of weather, as to his position. Jonathan Williams afterwards, in speaking of the importance which the discovery of these warm and cold currents would prove to Navigation, pertinently asked the question—"If these stripes of water had been distinguished by the colors of red, white and blue, could they be more distinctly discovered than they are by the constant use of the thermometer?" And he might have added, could they have marked the position of the ship more clearly?

When his work on Thermometrical Navigation appeared, Commodore Truxton wrote to him: "Your publication will be of use to Navigation, by rendering sea voyages secure far beyond what even you yourself will immediately calculate, for I have proved the utility of the thermometer very often since we sailed together.

"It will be found a most valuable instrument in the hands of mariners, and particularly as to those who are unacquainted with astronomical observations; * * these particularly stand in need of a simple method of ascertaining their approach to or distance from the coast, especially in the winter season; for it is then that passages are often prolonged, and ships blown off the coast by hard westerly winds, and vessels get into the Gulf Stream without its being known; on which account they are often hove to by the Captains supposing themselves near the coast, when they are very far off, (having been drifted by the currents.) On the other hand, ships are often cast on the coast, by sailing in the eddy of the stream, which causes them to outrun their common reckoning. Every

year produces new proofs of these facts, and of the calamities incident thereto."

These obstructions to Navigation in winter must therefore have operated strongly against the commerce of the North, and in favor of that of the South. And as far as Philadelphia is concerned, which was the commercial emporium of the North at that day, the list of arrivals there in winter, 60 or 70 years ago, shows that such was the case in an eminent degree.

Though the warm temperature of the Gulf Stream was discovered in 1775, yet, for political reasons, the discovery was not generally made known 'till 1790. Its immediate effect in Navigation, was to make the ports of the North as accessible in winter as in summer. What agency this circumstance had in the decline of the direct trade of the South, which followed this discovery, would be, at least to the political economist, a subject for much curious and interesting speculation. I have referred to the commercial tables of the time, and have compared the trade of Charleston with that of the Northern cities for several years, both before and after the discovery of Dr. Franklin became generally known to Navigators. The comparison shows an immediate decline in the Southern trade and a wonderful increase in that of the North. But whether this discovery in Navigation and this revolution in trade stand in the relation of cause and effect, or be merely a coincidence let others judge.

In 1769, the commerce of the two Carolinas, equalled that of all the New England States together, it was more than double that of New York, and exceeded that of Pennsylvania by one third.* In 1792, the exports from New York amounted in value to two millions and a half; from Pennsylvania to $3,820,000; and from Charleston alone to $3,834,000.

But in 1795, by which time the Gulf Stream began to be as well understood by Navigators as it now is, and the average passages from Europe to the North were shortened nearly one half, while those to the South remained about the same, the customs collected at Philadelphia alone amounted to $2,941,000,† or more than one half of those collected in all the States together.

Moreover, it may stay upon the lips of some ultra utilitarian, the untimely "*cui bono*," with its implied objections to the proposition now before the Institute.

Nor did the effects of the Doctor's discovery end here. Before it was made, the Gulf Stream was altogether insidious in its effects. By it, vessels

These statistics are given, and the subject is mentioned in this connection, not because it is proposed the National Institute should roam at large in such a field; but because they give point to illustration, and show how ramified and important in its bearings, is one single fact gathered from nature.

* *From McPherson's Annals of Commerce, Exports and Imports in* 1769, *valued in sterling money.*

EXPORTS.

	To Great Britain.	*S. of Europe.*	*W. Indies.*	*Africa.*	*Total.*
	L. s. d.	*L. s. d*	*L. s. d.*	*L. s. d*	*L. s. d.*
New England - -	142.775 12 9	81.173 16 2	308.427 9 6	17.713 0 9	550.089 19 2
New York - -	113.382 8 8	50.885 13 0	66.324 17 5	1.313 2 6	231.906 1 7
Pennsylvania - -	28.112 6 9	203.762 11 11	178.331 7 8	560 9 9	410.756 16 1
N. & S. Carolina -	405.014 13 1	76.119 12 10	87.758 19 3	691 12 1	569.584 17 3
		IMPORTS.			
New England - -	223.695 11 6	25.408 17 9	314.749 14 5	180 0 0	564.034 3 8
New York - -	75.930 19 7	14.927 7 8	97.420 4 0	697 10 0	188.976 1 3
Pennsylvania - -	204.979 17 4	14.249 8 4	180.591 12 4		399.830 18 0
N. & S. Carolina. -	327.084 8 6	7.099 5 10	76.269 17 11	137.620 10 0	535.714 2 3

† *Value of Exports in Dollars.*‡

	1791	1792	1793	1794	1795	1796
Massachusetts -	2.519,651	2,888,104	3,755,347	5,292,441	7,117,907	9,949,345
New York - - -	2,505,465	2,535,790	2,932,370	5,442,000	10,304,000	12,208,027
Pennsylvania - -	3,436,000	3,820,000	6,958,000	6,643,000	11,518,000	17,513,866
S. Carolina - - -	2,693,000	2,428,000	3,191,000	3,868,000	5,998,000	7,620,000

Duties on Imports in Dollars.§

	1791	1792	1793	1794	1795	1796	1833
Massachusetts	1,006,000	723,000	1,044,000	1,121,000	1.520,000	1,460,000	3,055,000
New York	1,334,000	1,173,000	1,204,000	1,878,000	2,028,000	2,187,000	10,713,000
Pennsylvania	1,466,000	1,100,000	1,823,000	1,498,000	2,300,000	2,050,000	2,207,000
S. Carolina	523,000	359,000	360,000	661,000	722,000	66,000	389,000

‡ Doc. No. 330. H. R. 2nd Sess., 25 Congress.

§ *Ibid.* Some of these statements do not agree with those taken from McPherson and previously quoted.

were frequently drifted many miles out of their course without knowing it, and in bad or cloudy weather when many days would intervene from one observation to another, the set of the current, though really felt for but a few hours during the interval, could only be proportioned out equally among the whole number of days. Therefore Navigators could have only very vague ideas, either as to the strength, or the actual limits of the Gulf Stream until they were marked out to the Nantucket fishermen by the whales, or made known by Capt. Folger to Dr. Franklin. The discovery, therefore, of its high temperature assured the navigator of the presence of a current of surprising velocity, and which, now turned to certain account, would hasten, as it had retarded his voyage in a wonderful degree.

Such, at the present day, is the degree of perfection to which nautical tables and instruments have been brought, that the Navigator may now detect, and with great certainty, every current that thwarts his way. He makes great use of them. Col. Sabine, in his passage a few years ago, from Sierra Leone to New York, was drifted 1,600 miles of his way by the force of currents alone; and, since the application of the thermometer to the Gulf Stream, the average passage from England has been reduced from upwards of eight weeks, to a little more than four. This may, in some degree, be owing to the improvement in ship building, but it is less owing, I apprehend, to any increased speed of vessels, than to a better knowledge of winds and currents; for the "Constitution" and the "United States" are, at this day, the fastest ships in the Navy; and they are models of the last century.

There is a current constantly setting into the Mediterranean to supply the waste, it is said, of evaporation. Now, on account of climate, the evaporation from the Gulf of Mexico in summer, must be much greater than from the Mediterranean; moreover, the rivers which empty into the Gulf are all at low water in summer; yet the Gulf Stream is said to run with much greater velocity in summer than in winter. If so, it is reasonable to suppose that the waters of the Gulf are higher at one season than another. But we have Light houses at the Tortugas, the Balize, Mobile and Pensacola, and keepers at them who would be glad of the employment. A tide staff planted at each, and daily registered for a year or two, would show whether there be a winter and a summer level to the Gulf, and thus settle this interesting question.

The manner in which the Florida Straits open out into the Atlantic—inclining to the Westward of North, the contour of the adjacent coast, the deep indent in the shore line here, between St. Augustine and Savannah, all seem to indicate a close pressure of the Gulf Stream and its counter current upon this part of the coast.* If so, the course of the Gulf Stream as it disembogues in the Atlantic, must be a little to the West, instead of a little to the East of North as our charts represent it. My own information, derived from the observations of an intelligent brother officer, goes to confirm this opinion; should it be proved correct, it will explain the anomaly often remarked upon by Navigators with regard to a stronger current in the Gulf Stream off Cape Hatteras, than further South, for then, this circumstance may be accounted for by the Chart course leading them on the outer edge of the Gulf Stream until it reaches the Carolina Capes, where they again get into the strength of it.

The place of embouchure for the Gulf Stream, is about the latitudinal limits of the Trade winds, where calms and variables prevail; and where aid from currents is most desirable. Our West India Cruisers are continually passing up and down this part of the stream; a few turns to and fro across it, by them, would show how the thread of the current does lie, of which we are now ignorant. It might materially shorten the passage of vessels bound North from the Gulf.

The Gulf Stream, as it issues from the straits of Florida, is of a dark indigo blue; the line of junction between it and the *roily* green water of the Atlantic, is plainly seen for hundreds of miles. Though this line is finally lost to the eye as the stream goes North, it is preserved to the thermometer for several thousand miles, yet to this day the limits of the Gulf Stream, even in the most frequented parts of the ocean, though so plainly marked, are but vaguely described on our charts. Thousands of vessels cross it every year; many of them make their observations upon it, and many more, if invited would do the same. But no one has invited coöperation; consequently there is no system, and each one that observes, observes only for himself; and when he quits the sea, his observations go with him and are to the world as though they had not been.

Captain Manderson of the Royal Navy published, many years ago, "An examination into the true cause of the Florida stream," which he ascribed to the Mississippi and the floods of the other rivers emptying into the Gulf. But judging from what we see going on daily in the Mediterranean, the water from the rivers, especially in summer when the Gulf Stream runs at the greatest velocity, are not sufficient to supply the waste of evaporation. Taking the hypothesis of the English officer for granted, it was asserted by another writer, that the velocity of the Gulf stream might be determined by the freshets in the Mississippi. Capt. Li-

* *April* 3. This opinion is still further confirmed by authentic statements, which I have heard, that the islands on the coast of Georgia bear marks of abrasion from the sea.

vingston put these theories to rest by showing that the volume of waters discharged through the Gulf Stream, exceeds what is emptied from the Mississippi by more than three thousand times.

Upon the ruins of this hypothesis which Capt. Livingston had so completely overturned, he advanced the opinion that the velocity of the Gulf Stream "depends on the motion of the sun in the Ecliptic, and the influence he has upon the waters of the Atlantic." To this day our books on navigation quote this opinion without comment.

The most generally received opinion, however, is the one repeated by Dr. Franklin, that the Gulf Stream is the escaping of the waters that have been *forced* into the Carribbean sea by the Trade winds; and that it is the pressure of those winds upon the water, which forces up into that sea a head, as it were, for this stream.

We know of instances in which waters have been accumulated on one side of a lake, or in one end of a canal, at the expense of the other. But they are rare, sudden and partial, and for the most part confined to sheets of shoal water where the ripples are proportionably great. As far as they go, the pressure of the Trade winds may *assist* to give the Gulf Stream its initial velocity; but is it of itself adequate to such an effect? To my mind, the laws of Hydrostatics as at present expounded, appear by no means to warrant the conclusion that it is, unless the aid of other agents also be brought to bear.

Supposing the pressure of the waters that are *forced* into the Carribbean sea by the Trade winds to be the *sole* cause of the Gulf Stream, that sea and the Mexican Gulf should have a much higher level than the Atlantic. Accordingly, the advocates of this theory require for its support "a great degree of elevation." Major Rennell likens the stream to "an immense river descending from a higher level into a plain." Now we know very nearly the average breadth and velocity of the Gulf Stream in the Florida pass. We also know, with a like degree of approximation, the velocity and breadth of the same waters off Cape Hatteras. Their breadth here is about 75 miles against 32 in the "Narrows" of the Straits, and their mean velocity is 3 knots off Hatteras, against 4 in the "Narrows." This being the case, it is easy to show that the depth of the Gulf Stream off Hatteras is not so great as it is in the "Narrows" of Bemini by nearly 50 per cent, and that consequently, instead of *descending*, its bed represents the surface of an inclined plane from the North, *up* which the lower depths of the stream *must* ascend. If we assume its depth off Bemini to be 200 fathoms, which are thought to be within limits, the above rates of breadth and velocity will give 114 fathoms for its depth off Hatteras. The waters therefore, which in the straits are below the level of the Hatteras depth, so far from descending, are actually forced up an inclined plane, whose submarine ascent is not less than 10 inches to the mile!

The Niagara is an "immense river descending into a plain." But instead of preserving its character in Lake Ontario as a distinct and well defined stream for several hundred miles, it spreads itself out, and its waters are immediately lost in those of the Lake. Why should not the Gulf Stream do the same? It gradually enlarges itself it is true; but instead of mingling with the ocean by broad spreading as the "immense rivers" descending into the Northern lakes do, its waters, like a stream of oil in the ocean, preserve their distinctive character for more than 3,000 miles.

Moreover, while the Gulf Stream is running to the North from its supposed elevated level at the South, there is a cold current coming down from the North; meeting the warm waters of the Gulf midway the Ocean, it divides itself and runs by the side of them right back into those very reservoirs at the South, to which theory gives an elevation sufficient to send out entirely across the Atlantic a jet of warm water said to be more than three thousand times greater in volume than the Mississippi river. This current from Baffin's Bay has not only no trade winds to give it a head; but the prevailing winds are unfavorable to it, and for a great part of the way it is below the surface, and far beyond the propelling reach of any wind. And there is every reason to believe that this polar current is quite equal in volume to the Gulf Stream. Are they not the effects of like causes? If so, what have the trade winds to do with the one more than the other?

It is a custom often practised by sea-faring people to throw a bottle overboard, with a paper stating the time and place at which it is done. In the absence of other information as to currents, that afforded by these mute little Navigators is of great value. They leave no tracks behind them, it is true? and their routes can not be ascertained. But knowing where they were cast, and seeing where they are found, some idea may be formed as to their course. Straight lines may at least be drawn, showing the shortest distance from the beginning to the end of their voyage, with the time elapsed. I hold in my hand a chart representing in this way the tracks of more than one hundred bottles. From it, it appears that the waters from every quarter of the Atlantic, tend toward the Gulf of Mexico and its Stream. Bottles cast into the sea midway between the old and the new worlds, near the coasts of Europe, Africa and America, at the extreme North or furthest South, have been found either in the West Indies, or within the well known range of the Gulf Stream.

Of two cast out together in South latitude on the coast of Africa, one was found on the island of "Trinidad," the other on Guernsey, in the English channel.

In the absence of positive information on the subject, the circumstantial evidence that the latter performed the tour of the Gulf, is all but conclusive.

Another bottle thrown over off Cape Horn by an American master in 1837, has been recently picked up on the coast of Ireland. An inspection of the chart and of the drift of the other bottles seems to *force* the conclusion, that this bottle too went even from that remote region to the so called *higher* level of the Gulf Stream reservoir.

Midway the Atlantic, in the triangular space between the Azores, Canaries and the Cape de Verd Islands, is the Sargasso Sea. Covering an area equal in extent to the Mississippi valley, it is so thickly matted over with Gulf weed (fucus natans) that the speed of vessels passing through it, is often much retarded. When the companions of Columbus saw it, they thought it marked the limits of Navigation and became alarmed. To the eye, at a little distance, it seems substantial enough to walk upon. Patches of the weed are always to be seen floating along the Gulf Stream. Now if bits of cork or chaff, or any floating substance be put into a basin, and a circular motion be given to the water, all the light substances will be found crowding together near the centre of the pool, where there is the least motion. Just such a basin is the Atlantic Ocean to the Gulf Stream, and the Sargasso Sea is the centre of the whirl. Columbus first found this weedy sea in his voyage of discovery, there it has remained to this day, and certain observations as to its limits extending back for fifty years, assure us that its position has not been altered since that time. This indication of a circular motion by the Gulf Stream is corroborated by the bottle chart and other sources of information. If, therefore, this be so, why give the endless current a higher level in one part of its course than another?

Nay more. At the very season of the year when the Gulf Stream is rushing in greatest volume through the straits of Florida and hastening to the North with the greatest rapidity, there is a cold stream from Baffin's Bay, Labrador, and the coasts of the North, running to the South with equal velocity. Where is the Trade wind that gives the high level to Baffin's Bay, or that even presses upon or assists to put this current in motion? The agency of winds in producing currents in the deep sea must be very partial. These two currents meet off the Grand Banks, where the latter is divided. One part of it underruns the Gulf Stream, as is shown by the icebergs which are carried in a direction tending across its course. The probability is, that this "fork" continues on towards the South and runs into the Carribbean Sea, for the temperature of the water at a little depth there, has been found far below the mean temperature of the earth, and quite as cold as at a corresponding depth off the Artic shores of Spitsbergen.

More water can not run from the equator, or the pole, than to it. If we make the trade winds cause the former, some other wind must produce the latter; but these, for the most part, and for great distances, are *submarine* and therefore beyond the influence of winds. Hence, it should appear that *winds* have little to do with the general system of aqueous circulation in the Ocean.

The other "fork" runs between us and the Gulf Stream to the South as already described. As far as it has been traced, it warrants the belief that it too runs *up* to seek the so called *higher* level of the Mexican Gulf.

The power necessary to overcome the resistance opposed to such a body of water as that of the Gulf Stream, running several thousand miles without any renewal of impulse from the forces of gravitation or any other known cause, is truly surprizing. It so happens, that we have an argument for determining, with considerable accuracy, this resistance which the waters of this stream meet with in their motion towards the East. Owing to the diurnal rotation, they are carried around with the earth on its axis *towards the East* with an hourly velocity 127* miles greater when they enter the Atlantic than when they arrive off the banks of New Foundland. In consequence of the difference of latitude between the parallels of these two places, their rate of motion around the axis of the earth is reduced from 925† to 758 miles the hour.

Therefore this immense volume of water, in passing from the Bahamas to the Grand Banks, meets with an opposing force in the shape of resistance, sufficient in the aggregate to retard it two miles and a half the minute, and this only in its Eastwardly rate. There is, doubtless, another force quite as great, retarding it towards the North, for its course shows that it is the resultant of two forces acting in different directions. If the former resistance be calculated according to received laws, it will be found equal to several atmospheres. And by analogy, how inadequate must the pressure of the gentle trade winds be to such resistance, and to the effect assigned them? If, therefore, in the proposed inquiry we search for a propelling power no where but in the higher level of the Gulf, we must admit, in the head of water there, the existence of a force capable of putting in motion and of driving over a plain, at the rate of 5 miles the hour, all the waters as fast as they can be brought down by 3,000 such streams as the Mississippi river—a power at least sufficient to overcome the resistance required to reduce from two miles

*In this calculation the earth is treated as a perfect aphere, with a diameter of 7925.56 miles.

†Or 915,26 to 758,60. On the latter parallel, the current has an East set of about 1¼ miles the hour—making the true velocity to the East and on the axis of the earth about 760 miles the hour at the Grand Banks.

and a half to a few feet per minute, the velocity of a stream that keeps in perpetual motion one fourth of all the waters in the Atlantic Ocean.

The facts, from observation on this interesting subject, afford us at best, but a mere glimmer of light, by no means sufficient to make my mind clear as to a *higher level** of the Gulf, or as to the sufficiency of any other of the causes assigned for this wonderful stream. If it be necessary to resort to a higher level in the Gulf, to account for the velocity off Hatteras, I cannot perceive why we should not, with like reasoning, resort to a higher level off Hatteras also, to account for the velocity off the Grand Banks; and thus make the Gulf Stream, throughout its circuit, a *descending* current, and by the *reductio ad absurdum*, show that the Trade winds are not adequate to the effect ascribed.

When facts are wanting, it often happens that hypothesis will serve, in their stead, all the purposes of illustration. Let us, therefore, suppose a globe of the earth's size, having a solid nucleus and covered all over with water 200 fathoms deep! and that every source of heat and cause of radiation be removed, so that its fluid temperature becomes constant and uniform throughout. On such a globe, the equilibrium remaining undisturbed, there would be neither wind nor current. And the poet's picture would apply to every sea:

> "Still as a slave before his lord
> The Ocean hath no blast;
> His great bright eye most silently
> Up to the moon is cast."

Let us now suppose that all the water within the tropics, to the depth of 100 fathoms, suddenly becomes oil. The aqueous equilibrium of the planet is thereby disturbed, and a general system of currents, and counter currents is immediately commenced—the oil in an unbroken sheet on the surface running towards the poles, and the water in an under current, towards the equator. The oil is supposed, as it reaches the polar basin, to be re-converted into water, and the water to become oil as it crosses Cancer and Capricorn, rising to the surface and returning as before.

Thus, *without wind*, we should have a perpetual and uniform system of tropical and polar currents. In consequence of diurnal rotation of the planet on its axis, each particle of oil, were resistance small, would approach the poles on a spiral turning to the East, with a relative velocity greater and greater, until, finally, it would reach the pole and whirl about it at the rate of nearly a thousand miles the hour. Becoming water and losing its velocity, it would approach the tropics by a similar, but inverted, spiral turning towards the West. Owing to the principle here alluded to, all currents from the Equator to the poles should have an Eastward tendency, and all from the poles towards the equator, a Westward.

Let us now suppose the solid nucleus of this hypothetical globe to assume the exact form and shape of the bottom of our seas and in all respects, as to figure and size, to represent the shoals and islands of the sea, as well as the coast lines and continents of the earth. The uniform system of currents just described would now be interrupted by obstructions and local causes of various kinds, such as unequal depth of water, contour of shore lines, &c.; and we should have, at certain places, currents greater in volume and velocity than at others. But still there would be a system of currents and counter currents to and from either pole and the equator. Now do not the cold waters of the North, and the warm waters of the Gulf made specifically lighter by tropical heat, which we see actually preserving such a system of counter currents, hold, at least in some degree, the relation of the supposed water and oil.

Apparently, in obedience to the laws here hinted at, there is a constant tendency of polar waters towards the tropics and of tropical waters towards the poles. The Exploring Expedition crossed one of these hyperborean currents 200 miles in breadth at the equator. There is also one near our own coast, another on the West coast of South America, as well as several others elsewhere known to exist; but for obvious reasons they are, for the most part, submarine and but little understood.

Counter to these are the Gulf Stream and the Lagullas current, besides numerous others more gentle and partial and therefore less marked in their character. But why one of these currents should always run from the Gulf of Mexico and the other along the coast of Africa, seems to demand the presence of other agents. Perhaps these may be found in local causes, such as the contour of coasts, the constant force of Trade winds, high temperature of the Gulf, &c. These would give the first impulse, and may be adequate to the initial velocity of the Gulf Stream.

Assuming its maximum velocity at 5 knots, and its depth and breadth in the Narrows of Bemini, as before, the vertical section across would present an area of two hundred millions of square feet moving at the rate of 7 feet 3 inches per second. The difference of specific gravity between the volume of Gulf water that crosses this sectional line in one second, and an equal volume of water at the ocean temperature of the latitude, is fifteen millions of pounds. If these estimated dimensions (assumed here—as throughout this paper they have been—upon the best authority, but merely for the purposes of illustration,) be within limits, then the force per second, operating here to propel

* The Gulf, or Carribbean Sea, may have, towards the channel of Yucatan, a higher level of a few inches and such only as is due to any other large stream of 3 or 4 knots when deflected in its course, as the Carribbean currents are, between their entrance into that sea and their exit from the Gulf.

the waters of the Gulf towards the pole, is the equilibrating tendency due to 15 millions of pounds of water in the latitude of Bemini.

In drawing up a plan for investigating the currents of the seas, such agencies should be taken into account. As a cause, I doubt whether this one is sufficient of itself to produce a stream of such great velocity as that of the Gulf; for, assuming its estimated discharge to be correct, the proposition is almost susceptible of mathematical demonstration, that to overcome the resistance opposed in consequence of its velocity, would require a force at least sufficient to drive, at the rate of 3 miles the hour, ninety thousand millions of tons up an inclined plane, having an ascent of 3 inches to the mile.* Yet the very principle from which this agent is derived, is admitted to be one of the chief causes of those winds which are said to be the sole cause of this current.

But, in addition to this, may there not be a peculiar system of laws not yet revealed, by which the motion of fluids in such large bodies is governed when moving through each other in currents of different temperature. That currents of sea water, having different temperatures, do not readily commingle, is shown by the fact already mentioned: that the line of separation between the warm waters of the Gulf and the cold waters of the Atlantic is perfectly distinct to the eye for several hundred miles; and even at the distance of a thousand miles, though the two waters have been in contact and continued agitation for many days, the thermometer shows that the cold water on either side still performs the part of river banks in keeping the warm waters of the stream in their proper channel.

In a winter's day off Hatteras, there is a difference between these waters of near 20°. Those of the Gulf being warmer, we are taught to believe that they are lighter; they should therefore occupy a higher level than those through which they float. Assuming the depth here to be 114 fathoms, and allowing the usual rates of expansion, figures show that the middle of the Gulf Stream here should be nearly 2 feet higher than the contiguous waters of the Atlantic. Were this the case, the surface of the stream would present a double inclined plane, from which the water would be running down on either side, as from the roof of a house. As this ran off at the top, the same weight of colder water would run in at the bottom; and thus, before this mighty stream had completed half its course, its depths would be brought up to the surface, and its waters would be spread out over the ocean. Why then does not such a body of warm water, flowing and adhering together through a cold sea, obey this law, and occupy a higher level? That it does not, we may infer from the silence of Navigators on the subject, as well as from other circumstances. If it did, the upper edges of its cold banks would support a lateral pressure of at least 100 lbs to the square foot; and vessels, in crossing it, would sail over a ridge as it were; on the East side of which, they would meet an Easterly current; and on the West side, a Westerly current. The resolution of the forces of each of these currents, with the Northwardly set of the stream itself, would induce Navigators to report a North Eastwardly current as they ascend the other side of this ridge, and a North Westwardly current as they descend on this; yet never was it heard that the Gulf Stream runs North West.

Should this *roof* current be too superficial to be felt by a vessel, the Gulf weed and all the floating substances borne by the stream across the Atlantic would run off on either side. But there is little or no Gulf weed along it Western edge, and its prevalence on the Eastern side may be readily accounted for by the operation of quite another law. Why this warm water therefore should not appear lighter than cold water is a curious phenomenon that, as far as I know, has never been considered. It is worthy of investigation. Nor should the paradox as to a higher level—a double inclined plane in the Gulf Stream itself, escape attention. Dr. Lardner assures us, and such too is the doctrine not yet exploded from our popular works,* that sea water expands according to the laws of fresh; and from this circumstance he argues that the fish in polar seas are preserved by the cold water being on top and the warmer below. But deep sea soundings do not confirm this. With a surface temperature of 34°, Northern voyagers have obtained a temperature at the depth of several hundred fathoms of 25°, which, according to the received laws of expansion, should have the specific gravity of water at 55°. And a thermometer thrust down the throat of a fish caught in polar seas, has been said to stand at Zero. The journals of arctic cruizers assure us of the fact, that the deeper we go down in the Northern seas of America, the colder the water, while the warmth off the shores of Northern Europe increases as we go down; thus showing a warm stratum of water to be lighter than the cold in one part of the Ocean, and in another contiguous to it, to be heavier.

But to return to the mingling of the waters.—We know from a familiar experiment,† that oil placed on water in a state of rest exerts an obvious and sensible force to put itself in motion; and it is a fact well known to iron founders, that cold and therefore heavier iron,‡ will not sink in the

* Supposing there be no resistance from friction.

* Dr. Marcet shows that sea water contracts until it freezes.

† If a bit of paper cut in the shape of a comma be dipped in oil and laid on water, the oil, in running off, will cause the paper to spin round.

‡ A cannon ball dropped into a ladle of melted iron will not sink till it expands, grows red hot, and becomes lighter.

melted material. May there not exist between cold and warm sea water a tendency similar in some degree to that between oil and water? Seeing how great is the resistance encountered by the Gulf Stream in its Eastward motion, and how insufficient is any head of water in the Gulf to give it its Northward tendency, may there not exist between the waters of the stream and their fluid banks, always heaving and moving to the swell of the sea, a sort of *peristaltic* force, which, with other agents, assists to keep up and preserve this wonderful system of ocean circulation? We know that undulatory motion varies with temperature in certain other substances, and why should it not vary in water also?

Sir Isaac Newton has demonstrated, that the velocity of waves is in the subduplicate ratio of their breadths. Therefore, if two vessels in a calm, one in, and the other outside of the Gulf Stream, would each count the waves that pass, or the times that the vessel rolls from side to side, in any given time, we should have an argument for determining whether the oscillation of a wave in the Gulf Stream, be shorter or longer, whether its rise and fall be greater or less, or whether there be any difference whatever between a warm wave and the cold one from which it is generated. That the waters of the Gulf Stream are more troubled than those of the Atlantic we all know from the "ugly seas," which Navigators so much complain of there. Almost the last, if not the very last word heard from the unfortunate schooner Grampus, was contained in a letter stating how greatly that vessel was distressed by them.

But it is facts and not theory that we want. We have not enough of the former to build up any theory at all! Nor should I undertake the structure if we had. In planning a system of observations in this magnificent field, instructions should cover the whole ground, and the attention of observers should be directed to every point from which it is possible for light to come. Therefore, in throwing out these suggestions, sailor like, I have but cast over my bottles; perhaps they may be picked up at some distant day, perhaps they may never be heard of again.

In its course to the North, the Gulf Stream gradually tends more and more to the Eastward, until it arrives off the banks of Newfoundland, where its course is said to become due East. These banks, it has been thought, deflect it from its proper course, and cause it to take this turn. Examination will prove, I think, that they are in part the effect, certainly not the cause. It is here, that the frigid current already spoken of, with its icebergs from the North, are met and melted by the warm waters from the Gulf. Of course the loads of earth, stones and gravel brought down upon them are here deposited. Captain Scoresby, far away in the North, counted 500 icebergs setting out from the same vicinity upon this cold current for the South. Many of them loaded with earth, have been seen aground on the banks. This process of transferring deposites for these shoals has been going on for ages; and, with time, seems altogether adequate to the effect described.

Nay more, a geodetic examination as to the course of the Gulf Stream, does not render it by any means certain that it is turned aside by the Grand Banks of Newfoundland at all; but that, in its route from the coasts of Georgia as far towards the shores of Europe as its path has been distinctly ascertained, it describes the arc of a great circle as nearly as may be. Following the line of direction given to it after clearing the Straits of Florida, its course would be nearly on a great circle passing through the poles of the earth. That it should be turned from this and forced along one inclining more to the East, requires, after it leaves these straits, the presence of a new force to give it this Eastward tendency. And have we not precisely such a force in the rate at which different parellels perform their daily rounds about their axis? In consequence of this, the stream, when it first enters the Atlantic from the Gulf, is carried with the earth around its axis at the rate of two miles and a half the minute faster towards the East than it is when it sweeps by the Grand Banks of Newfoundland.

That this explanation as to its Eastward tendency should hold good, a current setting from the North towards the South, should have a Westward tendency. Accordingly, and in obedience to the propelling powers, derived from the rate at which different parallels are whirled around in diurnal motion, we find the current from the North, which meets the Gulf Stream on the Grand Banks, taking a South-*Westwardly* direction, as already described. It runs down to the tropics by the side of the Gulf Stream, and stretches as far to the West as our own shores will allow. Yet, in the face of these facts, and in spite of this force, both Major Rennell and M. Arago make the coasts of the United States and the shoals of Nantucket to turn the Gulf Stream towards the East.

The maximum temperature of the Gulf Stream is 86°, or about 9° above the Ocean temperature due the latitude. Increasing its latitude 10°, it loses but 2° of temperature. And after having run 3,000 miles towards the North, it still preserves, even in winter, the heat of summer. With this temperature, it crosses the 40th degree of North latitude, and there, overflowing its liquid banks, it spreads itself out for thousands of square leagues over the cold waters around, and covers the ocean with a mantle of warmth that serves so much to mitigate in Europe the rigors of winter. Moving now more slowly, but dispensing its genial influences more freely, it finally meets the British Islands. By these it is divided, one part going into the polar basin of

Spitsbergen, the other entering the Bay of Biscay, but each with a warmth considerably above Ocean temperature. Such an immense volume of heated water can not fail to carry with it beyond the seas a mild and moist atmosphere. And this it is which so much softens climate there.

We know not what the depth or the under temperature of the Gulf Stream may be. But *assuming* the temperature and velocity at the depth of 200 fathoms, to be those of the surface,* and taking the well-known difference between the capacity of air and of water for specific heat, as the argument, a simple calculation will show, that the quantity of heat discharged over the Atlantic from the waters of the Gulf Stream in a winter's day, would be sufficient to raise the whole column of atmosphere that rests upon France and the British Islands, from the freezing point to summer heat.

Every West wind that blows, crosses the stream on its way to Europe, and carries with it a portion of this heat to temper there the Northern winds of winter. It is the influence of this stream upon climate, that makes Erin the "Emerald Isle of the Sea," and that clothes the shores of Albion with evergreen robes; while in the same latitude on this side, the coasts of Labrador are fast bound in fetters of ice. In a valuable paper on currents,† Mr. Redfield states, that in '31, the harbor of St. John's, Newfoundland, was closed with ice as late as the month of June; yet, who ever heard of the port of Liverpool, on the other side, though 2° further North, being closed with ice, even in the dead of winter? The Baron Humboldt's isothermal curves show that the genial influence of this current is felt in Norway, and even on the shores of Spitsbergen in the polar basin. The mere sweeping of the winds over a large tract of ocean without any such warm stream, is not sufficient to produce such effects upon climate as is fully shown by comparing the climate of Spitsbergen with that of places similarly situated in the South Sea with regard to winds and water, but not with regard to currents.

Nor do the beneficial influences of this stream upon climate end here. The West Indian Archipelago is encompassed on one side by its chain of islands, and on the other by the Cordilleras of the Andes bending through the Isthmus of Darien and stretching themselves out over the plains of Central America and Mexico. Beginning on the summit of this range, we leave the regions of perpetual snow, and descend first into the *tierra témplada*, and then into the *tierra caliente*, or burning land. Descending still lower, we reach both the level and the surface of the Mexican Seas, where, were it not for this beautiful and benign system of aqueous circulation, the peculiar features of the surrounding country assure us we should have the hottest, if not the most pestilential climate in the world. As the waters in these two cauldrons become heated, they are borne off by the Gulf Stream, and are replaced by cooler currents through the Caribbean Sea; the surface water, as it enters here, being 3° or 4°, and that in depth, 40°‡ cooler than when it escapes from the Gulf. Taking this difference in surface temperature only, as the degree of heat accumulated there, a simple calculation will show, that the quantity of specific heat daily carried off by the Gulf Stream from those regions, and discharged over the Atlantic, is sufficient to raise mountains of iron from zero to the melting point, and to keep up from them a molten stream of metal greater in volume than the waters daily discharged from the Mississippi river. Who, therefore, can calculate the benign influences of this wonderful current upon the climate of the South? "Cui bono?" In the pursuit of this subject, the mind is led from nature up to nature's God. Who, therefore, in this Christian land, shall repeat the question? Or whose mind will the study of this subject not fill with profitable emotions? Unchanged and unchanging alone, of all created things, the Ocean is the great emblem of its everlasting Creator. He "treadeth upon the waves of the sea," and is seen in the wonders of the deep. Yea, "he calleth for its waters, and poureth them out upon the face of the earth." In obedience to this call, the aqueous portion of our planet preserves its beautiful system of circulation. By it, heat and warmth are dispensed to the extra-tropical regions; clouds and rain are sent to refresh the dry land; and by it, cooling streams are brought from Polar Seas to temper the heat of the torrid zone. At the depth of 240 fathoms, the temperature of the currents setting into the Caribbean Sea has been found as low as 48°, while that of the surface was 85°. Another cast with 386 fathoms gave 43° against 83° at the surface. The hurricanes of those regions agitate the sea to great depths: that of 1780 tore rocks up from the bottom in 7 fathoms, and cast them on shore. They therefore can not fail to bring to the surface portions of the cooler water below.

These cold waters doubtless come down from the North to replace the warm water sent through the Gulf Stream to moderate the cold of Spitsbergen; for within the Arctic Circle, the temperature at corresponding depths off the shores of that Island, is only one degree colder than in the Caribbean Sea; while on the coasts of Labrador the temperature in depth is 25°, or 7° below the freezing point of

* Which in all probability is not the case.

† American Journal of Science, Vol. 45, p. 293.

‡ From the journals of Mr. Dunsterville. } *Caribbean Sea.* { Surface temp. 83° Sept., 84° July, 83° —, 86½° Mosquito Coast. Temp. in depth 48°, 240, faths. 43°, 386 faths. 42°, 450 faths. 43. 500 faths.

fresh water. Capt. Scoresby relates, that on the coast of Greenland, in latitude 72°, the temperature of the air was 42°—of the water 34°, and 29° at the depth of 118 fathoms. He there found a current setting to the South, and bearing with it this extremely cold water, with vast numbers of icebergs whose centres, perhaps, were far below zero. It would be curious to ascertain the routes of these under currents on their way to the tropical regions, which they are intended to cool. One has been found at the equator 200 miles broad and 23° colder than the surface water. Unless the land or shoals intervene, it no doubt comes down in a spiral curve.

Perhaps the best indication as to these cold currents may be derived from the fish of the sea. The whales first pointed out the existence of the Gulf Stream by avoiding its warm waters. Along our own coasts, all those delicate animals and marine productions which delight in warmer waters are wanting; thus indicating by their absence the cold current from the North now known to exist there. In the genial warmth of the Sea about the Bermudas on one hand and California on the other, we find, in great abundance, those delicate shell fish and coral formations which are altogether wanting in the same latitudes along the shores of South Carolina. The same obtains in the West coast of South America; for there, the cold current almost reaches the line, before the first sprig of coral is found to grow.

A few years ago, great numbers of bonita and albercore—tropical fish—following the Gulf Stream, entered the English Channel, and alarmed the fishermen of Cornwall and Devonshire, by the havoc which they created among the pilchards there.

It may well be questioned if our Atlantic cities and towns do not owe their excellent fish markets, as well as our watering places, their refreshing sea bathing in summer, to this stream of cold water. The temperature of the Mediterranean is 4° or 5° above the Ocean temperature of the same latitude, and the fish there are very indifferent. On the other hand, the temperature along our coast is several degrees below that of the Ocean, and from Maine to Florida our tables are supplied with the most excellent of fish. The sheeps-head, so much esteemed in Virginia and the Carolinas, when taken on the warm coral banks of the Bahamas, loses its flavor and is held in no esteem. The same is the case with other fish: when taken in the cold water of that coast, they have a delicious flavor and are highly esteemed; but when taken in the warm water on the other edge of the Gulf Stream, though but a few miles distant, their flesh is soft and unfit for the table. The temperature of the water at the Balize reaches 90°. The fish taken there are not to be compared with those of the same latitude in this cold stream. New Orleans therefore resorts to the cool waters on the Florida coasts, for her choicest fish. The same is the case in the Pacific. A current of cold water from the South sweeps the shores of Chili, Peru and Columbia, and reaches the Gallipagos Islands under the line. Throughout this whole distance, the world does not afford a more abundant or excellent supply of fish. Yet, out in the Pacific, at the Society Islands, where coral abounds, and the water preserves a higher temperature, the fish, though they vie in gorgeousness of coloring with the birds, and plants, and insects of the tropics, are held in no esteem as an article of food. I have known sailors, even after long voyages, still to prefer their salt beef and pork to a mess of fish taken here. Therefore, let those who are curious as to the migratory habits of fishes, join hands in the proposed system of observations upon currents—for the few facts which we have bearing upon the subject, seem to suggest it as a point of the inquiry to be made, whether the habit of certain fish does not indicate the temperature of the water; and whether these cold and warm currents of the Ocean, do not constitute the great highways through which migratory fishes travel from one region to another.

Navigators have often met with vast numbers of young sea-nettles (medusæ) drifting along with the Gulf Stream. They are known to constitute the principle food for the whale; but whither bound by this route has caused much curious speculation; for it is well known that the habits of the whale are averse to the warm waters of this stream. An intelligent sea captain informs me, that two or three years ago, in the Gulf Stream on the coast of Florida, he fell in with such a "school of young sea-nettles as had never before been heard of." The sea was covered with them for many leagues. He likened them, in appearance on the water, to acorns floating on a stream. But they were so thick as completely to cover the sea. He was bound to England and was five or six days in sailing through them. In about sixty days afterwards, on his return, he fell in with the same school off the Western Islands, and here he was three or four days in passing them again. He recognized them as the same, for he had never before seen any like them; and on both occasions he frequently hauled up buckets full and examined them.

Now the Western Islands is the great place of resort for whales; and at first there is something curious to us in the idea, that the Gulf of Mexico is the harvest field, and the Gulf Stream the gleaner which collects the fruitage planted there, and conveys it thousands of miles off to the hungry whale at sea. But how perfectly in unison is it with the kind and providential care of that great and good Being which feeds the young ravens and caters for the sparrow!

Our information as to the Sargasso Sea is most barren. Whence comes the weed with which it is covered, or where its place of growth may be, is

matter of dispute among learned men. But as for the office which it performs in the economy of the Ocean, conjecture even is almost silent. Certain it is however, that that sea of weeds was not planted in the middle of the Ocean without design. The marks of intelligence, displayed throughout the whole system of terrestrial adaptations, forbid the idea. Botanists tell us of certain "nodding flowers" which, at a certain stage of growth, bend their heads, that the dust from the anthers may fall upon the stigma; when the necessary impregnation is accomplished, they become again erect. Now it is clear, if the stalk were stronger or weaker, if the force of gravity, or the size of the earth were greater or less, this operation could not take place, the flower would not yield seed after its kind, and the species must become extinct. Such is the delicate snow-drop of our garden walks. Therefore, at creation, when this little flower was put forth, the mass of the earth and the force of gravity must have been taken into account.

"There is something curious," says Professor Whewell, and he might have added profitable and instructive too, "in thus considering the whole mass of the earth, from pole to pole, and from circumference to centre as employed in keeping a snow-drop in the position most suited to its vegetable health." How much more forcibly must this adaptation and the necessary terrestrial arrangements apply to this sea and to the Gulf Stream, peopled, as no doubt they are, with myriads and myriads of living creatures! Even as to the depths of this sea we are ignorant; and as to the animals which the Gulf Stream conveys from one part of the Ocean to another, observation has told us scarcely a word. This is a fit subject of inquiry, and comes within the scope and reach of the plan proposed.*

The contemplated system of observations will be of high interest also to the meteorologist, whose science at this time is attracting so much attention. The fogs* of Newfoundland, which so much endanger Navigation in winter, doubtless owe their existence to the presence, in that cold sea, of immense volumes of warm water brought by the Gulf Stream. Sir Philip Brooke found the air on each side of it at the freezing point, while that of its waters was 80°. "The heavy, warm, damp air over the current produced great irregularities in his chronometers." The excess of heat daily brought into such a region by the waters of the Gulf Stream, if suddenly stricken from them, would be sufficient to make the whole column of superincumbent atmosphere ten times hotter than melted iron.

With such an element of atmospherical disturbance in its bosom, we might expect storms of the most violent kind to accompany it in its course. Accordingly, the most terrific that rage on the Ocean have been known to spend their fury in and near its borders.

Our nautical works tell us of a storm which forced this stream back to its sources, and piled up the water in the Gulf to the height of 30 feet. The Ledbury Snow attempted to ride it out. When it abated, she found herself high up on the dry land, and discovered that she had let go her anchor among the tree tops on Elliott's Key. The Florida Keys were inundated many feet, and the scene presented in the Gulf Stream was never surpassed in awful sublimity on the Ocean. The water thus dammed up, is said to have rushed out with won-

* The Sargasso sea is an immense pool, in which are gathered in great quantities, gulf weed, drift wood, wrecks, and all the floating substances cast upon the Atlantic. Waters from the Indian ocean, by the Lagullas current—from the frozen regions beyond Cape Horn, through the ice-bearing current from the Antartic seas—waters from the Arctic Ocean, through the Labrador current—all find their way into the Atlantic, and deliver whatever floating substances they bear, up to the Gulf Stream—whence, like the fucus natans, it gradually finds its way into this weedy sea, which is a basin in the Atlantic, between the Cape de Verds, Canaries, and Western Islands, quite equal in extent to the Mississippi valley.

Three hundred and fifty years ago, Columbus passed over this sea. It was then covered with weeds, as it now is, and as it no doubt had been for ages and ages before. What its depth, or the character of the bottom may be, we know not—we are even ignorant as to the place of growth for its weeds. Yet to the geologist, this is a volume brim full of unread studies and mysterious things—it is a type on a grand scale, of the gathering together the materials for his ancient coal formations—and to such an one, the round world no where else affords a parellel. It is the only page any where to be found, where time, with his everlasting characters, is now writing his commentary as to the manner and the means by which nature collected in her store houses the coal measures of the mountains.

This weed is not strewed over the sea in an unbroken sheet; it is arranged in seams and longitudinal sections, corresponding to the layers of coal in the coal basin. The sea is even free, in a great degree, from storms, and if we imagine that these weeds in the process of time, gradually wither, contract and sink, we shall have here a beautiful illustration as to the manner in which the coal seams were arranged in layers as we now see them among the mountains.

The bowsprit of the "Little Belt," lost in the West Indies, was found not long afterwards near the edge of the Sargasso.

In a former voyage, I once met upon its borders a rough spar of yellow pine, probably grown in one of our Southern States. It was covered with a beautiful crop of anatifae, interspersed with crabs, and surrounded by a school of dolphin. It had evidently been in the water a great while, for it was so water-soaked, that the wood had become translucent—almost as much so as thin slips of very "fat" light wood. Receiving a still heavier load of barnacles and molluscs, it would in time have reached this sea, and been borne down to the depths below with its load of inhabitants, there, before the next hour, be marked on the geolo-

* The dampness of the climate in England, as well as that here when Easterly winds prevail, is attributable also to the Gulf Stream.

derful velocity against the fury of the gale, producing a sea that beggared description.

The *great hurricane* of 1780 commenced at Barbadoes. In it, the bark was blown from the trees, and the fruits of the earth destroyed; the very bottom and depths of the sea were uprooted, and the waves rose to such a height that forts and castles were washed away, and their great guns carried many yards; houses were blown down, ships were wrecked, and the bodies of men and beasts lifted up above the earth and dashed to pieces in the storm. At the different islands not less than

gical time-piece, to be elaborated into the most beautiful and rare among fossils.

This basin is the great centre and receptacle of Atlantic drift. The moss and the lichen of the extreme North, brought down to the Grand Banks, are handed over on icebergs to the Gulf Stream, to be borne on towards this central whirl and lodged by the side of the larch and the fir of the farthest South, conveyed also by the ice-bearing* currents from Cape Horn. There too, in the caverns below, are to be found the flora and vegetables, with land shells, insects, etc., borne along with the drift wood from the river Gambia and the coast of Africa, from the Amazon and the Oronoco, the upper Missouri and lower Mississippi. In short, by reason of these currents and this sea of weeds, we have before our eyes the means of grouping in that basin, the most extended, varied, and magnificent collection of vegetable and animal matter that is known in any of the formations that have yet become *geological*.

That the drift wood from these regions should not be more often met with at sea, is not at all surprising. Barely floating at best, the prolific waters of the Gulf Stream soon load the floating trees with immense numbers of barnacles and shell fish. Many of them possess the power of expansion in a greater or less degree, and by a sort of concert of action, such as we see among corals and other fish, may possess the power of floating their shifting domicil at any depth. Finally reaching the Sargasso sea, the temperature of the water and other conditions become unfavorable to their animal health; they die, and thus the weight of the shells is sufficient to carry the whole tree, with its branches entire, down to the lower deposits, and place it there in the most gentle manner.

This process requires a very short time; hence it is, that floating drift-wood has not been met with in larger quantities in this sea. But some idea may be derived of the quantity of drift which is thus conveyed, from the fact, that the place of light house keeper at the Tortugas islands is considered one of the most profitable on account of its jetsam. The value of the copper and lead to be collected from the fragments of boats wrecked on the Mississippi, and drifted on the Tortugas, is considered by the keeper quite equal to his salary from the Government. Now these islands are on the very edge of the stream, and the materials from wrecked boats bear but a small proportion to the drift-wood brought down that river. Let therefore the imagination picture the mass of materials, that in the process of ages upon ages would be thus transported from the Mississippi valley, from the plains of the Oronoco and the head waters of the Amazon, from the banks of the St. Lawrence and the forests of Africa, from central America, the West Indies, and shores of Labrador, into the Sargasso sea.

This sea can be looked upon in no other light than as the germ of a future coal basin or peat bog, in which, at some remote day, when we perhaps shall have become fossils, and this part of the sea dry land, other geologists will roam, admire, speculate and dispute. Indeed, it requires but little stretch of the imagination to conceive that nature, with her corps of earthquake sappers and volcano miners, is now at work there, laying her train for a grand geological display of uplift and heave. Teneriffe and the Azores are volcanic; and but a few years ago, as if in warning, or to give note as to the state of preparation below, an island was cast up from the bottom, to sink again in this very sea.

But while the currents of the sea in one place are busied with the work of collecting and hiding in the middle of the ocean this vast assemblage of vegetable remains, they are employed on the out-skirts in collecting and arranging the materials for a formation of quite another sort. The ice-bearing currents from the North and the South bring down icebergs laden with earth, boulders and the carcasses of animals, to be deposited at one place upon the Grand Banks of Newfoundland, and at the other upon the Lagullas banks of South Africa. These are the places at which nature bids the tepid currents of the torrid zone to meet the icebergs from either pole, and to relieve them of their frigid loads of rocks and gravel. Are there not similar banks, at greater or less depth, near the junction of every ice-bearing current, with its equatorial counterpart?

Geology, through its mineral wealth and interests, it has been said, is at the bottom of the anti-corn law league in England. It certainly has something to do with the tariff doctrines of Pennsylvania; for without the iron and the coal of that and other States, legislators would argue less the question of home industry, tariff and protection. The learned chairman of this association had occasion a few weeks ago to point out the connection between geology and experiments upon the ballistic pendulum.* This all pervading science, through the currents of the sea, is quite as closely allied to navigation as, through the mineral wealth of the land, it is to legislation, custom-house laws, and Government revenue. Whose pursuits would seem to be farther apart than that of the geologist among the cliffs of the hills and the outcrops of the valleys, and that of the mariner among the billows of the sea? Meeting on the crest of two waves, they join hands across the Gulf Stream; the "weedy sea" is common ground, and the iceberg a volume of classic lore and high import; to one it is a type of ancient formations, to the other an index pregnant with meaning. In short, the facts collected by one are to the other points of the most valuable information.

The line of meeting between the waters of the Gulf Stream and the Atlantic is distinct to the naked eye for several hundred miles. This unreadiness of cold and tepid sea-water to commingle has been often remarked upon, and seems to impart to one current the power of dividing and turning others aside. Thus the Gulf Stream bifurcates the Labrador current, one part of which underruns the Gulf Stream, and the other takes a southwestwardly direction along the coast.

The reverse happens with the current from the Indian ocean, of which the Lagullas is a part. Here the cold current divides the warm one—one branch of which, as the Lagullas, after passing the Cape of Good Hope, is even turned back towards the northwest, while the other, the Australian, pursues its *natural* course to the southward and eastward, passing the island from which it takes its name.

Perhaps it was upon the tail of this or some other equa-

* I have seen icebergs borne up on this current into the South Atlantic as far North as lat. 37° S.

* In his paper before the National Institute, Captain Mordecai stated, that the sand used as a core in the pendulum had been compressed by impact from the ball, so as to adhere and present the appearance of sand-stone.

20,000 persons lost their lives on shore, while further to the North, the "Sterling Castle" and the "Dover Castle," men-of-war, were wrecked at sea, and fifty sail driven on shore at the Bermudas.

Several years ago, the British Admiralty set on foot inquiries as to the cause of the storms in certain ports of the Atlantic which so often rage with disastrous effects to Navigation. The result may be summed up in the conclusion to which the investigation led: that they are occasioned by the irregularity between the temperature of the Gulf Stream and of the neighboring regions both in the air and water.

Connected with and dependent upon this great artery of the Ocean, are numerous veins in the shape of eddies, counter currents, drifts and sets, all of the highest importance to Navigation, and to the neglect of which many frightful disasters among sea-faring people, are to be ascribed.

In 1804, H. M. ship "Apollo," left the cove of Cork with 69 sail under convoy for the West Indies. They encountered a current in the tail of the Gulf Stream of which they were not aware, and on the 7th day out, the "Apollo," with 40 of the convoy, were wrecked on the coast of Portugal.

It is the Navigator's ignorance of the force of currents on the coast of Africa that has done so much towards supplying the wandering Arabs of the desert with slaves, and that has given to the world such thrilling narratives as that of Adams wrecked in the "Charles," of Riley in the "Commerce," and of Paddock in the "Oswego." To this ignorance are attributed those horrid and revolting scenes enacted on the raft which was made from the wreck of the French frigate, "La Medusa." Hundreds of others whose wretched fate only is told in silence, by the plank upon the shore, owe their loss to our ignorance of currents.

In 1825, 800 sail of British shipping were lost at sea. And upon an average, one American and two British ships are wrecked every day the year round. Most of these losses are owing to the effects of unknown currents. I doubt whether a subject, more important in its bearings, was ever presented for the consideration of this Institution.

The field of investigation is most magnificent; when rightly understood, the system of marine currents and Ocean circulation cannot fail to open to us an arrangement not less beautiful and harmonious than the "music of the spheres." Though I have only glanced at some of the currents in the Atlantic, there are others, both there and in the Pacific, not less interesting and scarcely less important than these. Among them, circumstances seem to invite inquiry as to the probability of a "Gulf Stream" in the North Pacific. The resort of whales about Japan, as about Newfoundland in the same latitude—the European-like climate of Oregon—the thunder storms encountered in high Pacific latitudes out of season—the absence of whales in the

torial current that Captain Ross struck which enabled him to reach so much farther South than the American Ex. Expedition was enabled to do. This warm current—warm there only by comparison—was not perhaps strong enough to be detected by the log. It could only be shown by the thermometer; for if Captain Ross found a higher temperature than was found upon the same parallel by the vessels of the American Expedition in another part of the ocean, it would be fair to infer that the warmer waters were not made warmer on that parallel, but that they were drifted there from warmer regions. I have not seen either of the journals, nor have I heard a word as to any difference of temperature found by the two. It appears from the general system and arrangement of currents, that a flow of tropical water, of course of greatly reduced temperature, but still higher than that of the surrounding sea, should and ought to be found near the longitude by which Captain Ross approached the Antarctic. And I hope to have an opportunity of comparing temperatures. No doubt but the south pole is approached in some region by one or more, perhaps several tropical currents. Before attempting another voyage there, it would be highly desirable first to ascertain the route of that which is greatest in volume. Witness the effects of the Gulf Stream upon the temperature of the polar basin about Spitzbergen, as compared with the temperature at the same parallel in the North American seas.

In studying out the currents of the sea the mind has presented to it a most sublime subject for contemplation. It would be doing violence to the wisdom every where displayed through nature, to suppose that they are governed by other than wise, certain, harmonious and fixed laws. Through these laws, when rightly understood, the system of ocean circulation will present for contemplation an order and arrangement as beautiful and imposing as the geological column itself. Therefore this subject recommends itself for its beauty and grandeur to every well-balanced and cultivated mind. The "wonders of the deep" are more often alluded to in Holy Writ, and are more frequently used there in illustration of the power and greatness of the Creator than any other portion of his handy-work.

Therefore devout men—for the undevout geologist is as mad as the undevout astronomer—will receive from the proposed system of observations, many an instructive and profitable lesson. In never ceasing motion the waves of the sea lift up their voice continually. Whether heard in the raging of the storm or in the mute eloquence of the calm, they teach man his littleness, and tell of the power and attributes of the everlasting God.

Gentlemen here, and good men every where, can do much to aid this plan by giving it their countenance, and using their influence with masters by inducing them to send to Washington an abstract of their logs, though it contain only the track of the vessel, with the winds and temperatures. Even this would be valuable, and any thing additional would be much more so. Our whalemen do collect and have it in their power to give much truly valuable information. That which they collect concerns the meteorologist, the naturalist and others, not less than the navigator and geologist. Indeed, the ocean, with its almost unsealed book of mysteries, presents to the votary of science, whatever be the name of his association, a common highway, upon which each society, like every nation, may make its ventures and return, like them, in vessels laden with treasures to enrich the mind and benefit the human race.—*Extract from a "Paper on the Currents of the Sea as connected with Geology, read before the association of American Geologists and Naturalists, May* 14, 1744—*by M. F. Maury, Lt. U. S. N.*"

same region, all appear to indicate between North Western America and North Eastern Asia, the presence of a large body of warm water. The probability of such a current there seems to become stronger and its similarity to the Gulf Stream more striking, from the fact that the extreme cold of North Eastern Asia corresponds with our North Eastern climate, indicating thereby the existence of a cold current from the North, corresponding to that on our Atlantic coast, where certain cold water fish are known to resort.

If there be such a warm current from Sumatra and the China seas, perhaps it is spread out over a larger space, and does not by any means reach Gulf Stream velocity. Nor is it likely that it would be met in much force, so low down as vessels bound to China from Western America would cross it. As far as the collecting of facts from observations is concerned, this is a barren sea. Our standard directories of the Ocean do not inform us whether there be so much as a current* throughout the whole extra-tropical extent of the North Pacific. The time is fast approaching when that part of the Ocean too will become a great highway for ships. And any information that this Institute can collate in relation to it, would be highly valuable and most acceptable to Navigators. We have seen how useful currents become in the economy of the Ocean, and how important to its safe and speedy Navigation is a knowledge of them. In the beautiful system of cosmical arrangements and terrestrial adaptations, by which we are surrounded, they perform active and important parts: they not only dispense heat and moisture, and temper climates, but they prevent stagnation in the sea, and by their active circulation, transport food and sustenance for its inhabitants from one region to another, and people all parts of it with life and animation. Yet, on this interesting subject, former observations have thrown just light enough to make visible the darkness through which we are groping.

"The discovery," says the Baron Humboldt, "of a group of uninhabited islands is less interesting than a knowledge of those laws which bind together a considerable number of facts."

Therefore be diligent—let the plan of observations cover broad grounds, and occupy the whole field. The perfection to which chronometers have been brought; the nicety of our instruments; the accuracy of the nautical ephemeris; the convenient arrangement of the requisite tables—and, above all, the intelligence and skill of the multitudes of laborers that now stand idle, but ready, all combined, enable us to conduct a system of observations upon the phenomena of the sea, with advantages which no other age has afforded since the world began.

It may be asked how a society, in its very infancy and without means, can occupy with observers a field like this, as wide as the poles and as broad as the sea?—In answer, I would point to the Navy and our commercial marine—with such materials and with its honors and the hope of its honorary rewards rightly applied, the moral influence of the Institute can accomplish more than the mines of Potosi.

In whatever may tend to the improvement of Navigation, or redound to the credit of their country, the officers of the Navy have always been ready. Any plan, therefore, for collecting facts and systematizing observations in the fields proposed, is sure to receive from them the most zealous and hearty coöperation, when it does not interfere with their more immediate duties.

The commercial marine of no country in the world can boast of ship masters superior to the Americans as Navigators and in general intelligence. Their industry and enterprize warrant the expectation that they too would join hands in the undertaking most readily. Personal knowledge of them warrants the belief, that at the invitation of the Institute they would undertake a series of observations upon any plan the society may propose.

* Captain, now Admiral, Dupetit Thuars found a surface temperature of 79° one thousand miles to the East of Japan, which thereby indicates such a stream. And this is further confirmed by the opinion of Mr. Redfield, who has formed his conclusions from information derived from American whalers.

A BIVOUAC IN THE DESERT.

BY MARY E. HEWITT.

"After the battle of the Pyramids, the whole way through the desert was tracked with the bones and bodies of men and animals, who had perished in these dreadful wastes. In order to warm themselves at night, they gathered together the dry bones and bodies of the dead, which the vultures had spared, and *it was by a fire composed of tihs fuel that Napoleon lay down to sleep in the desert!*"

[*Miot's Memoirs.*

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The ploughshare of the conqueror passed
Across the burning desert plain;
While on the sower followed fast,
And scattered in the bright red grain.

And tracking on that welded blade,
Forged from their countless battle-brands;
Far o'er the broad, deep furrow made,
On swept his trained Prætorian bands.

The vulture is the desert's king!
And what of conquerors recketh he?
Who bounds his empire by his wing,
Reigneth, I ween, right fearlessly!

'Twas night—the conqueror's harvest night—
No star in heaven its glories hid;